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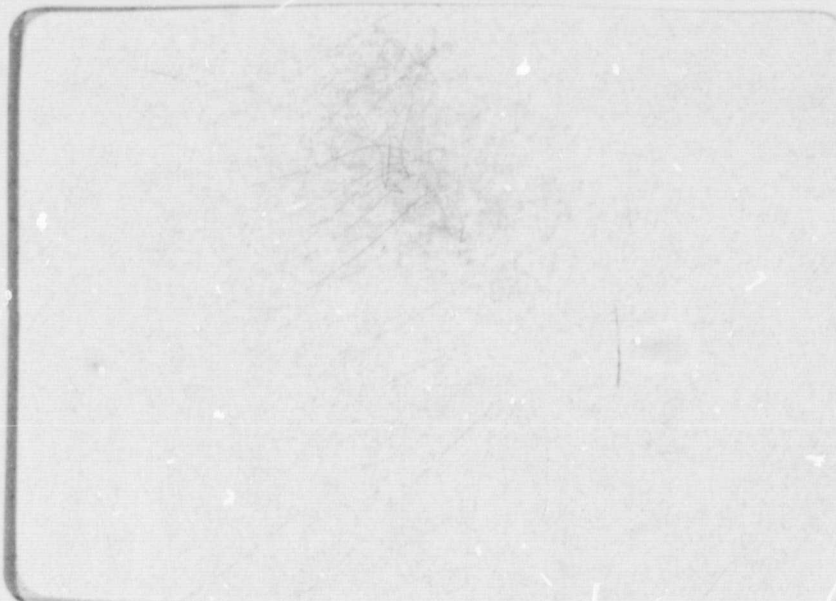
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(E83-10075) INPE LANDSAT-D THEMATIC MAPPER
COMPUTER COMPATIBLE TAPE FORMAT
SPECIFICATION (Instituto de Pesquisas
Espaciais, Sao Jose) 68 p HC A04/MF A01

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INSTITUTO DE PESQUISAS ESPACIAIS

INPE TM CCT FORMAT (SUMMARY)
Prepared for the 3rd LTWG Meeting (October, 1982)

1. General Guidelines Followed:

- member of the Standard Family of Tape Formats
- suitable for different user applications
- compatible with other countries' formats

As a result, the format came out similar to NASA and CCRS formats, closer to CCRS.

2. Product Characteristics

- one quadrant of a standard WPS scene, from one to seven bands in any combination; a full-frame CCT is optional but intended for internal use only.
- BIL or BSQ at 800 or 1600 bpi.
- reverse scan inverted; detector and band offsets compensated through pad pixels.
- no resampling performed; both raw PCD and processed geometric data included in the header file to allow user processing at different levels.
- video data radiometrically corrected or not; radiometric elements included in the header file to allow user radiometric processing if desired.

3. Product Organization

Besides the Volume Directory Files, used as recommended in the Standard, the INPE TM CCT has:

- One Header File containing
 - Interval-related data
 - Radiometric elements
 - Temperature data
 - Raw Attitude and ephemeris data
 - Raw jitter measurements
 - Processed ephemeris data
 - Map projection data (SOM or UTM)
 - Pixel-to-geographic coordinates correspondence model
 - Radiometric calibration data
 - Annotation data

- One (BIL) or up to seven (BSQ) Imagery Files containing records with
 - Prefix data (scan line no., time code, fill pixel counts)
 - Image data in 8-bit unsigned bytes
 - Suffix data (scan line quality, etc)

There is no Trailer File in this Format.

4. Quadrants Definition

Quadrants are numbered counterclockwise from upper right; there is no overlap between quadrants and the scene center is considered as being on pixel 3245 of band 1 at line 3089. This is the uppermost-leftmost pixel of quadrant 4. INPE intends to use 5 additional "quadrants" centered in intermediate positions among the 4 first quadrants, the last one being centered on the full scene center.

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INPE LANDSAT-D THEMATIC MAPPER
COMPUTER COMPATIBLE TAPE
FORMAT SPECIFICATION

Author : Ricardo Cartaxo Modesto de Souza

Date : 04 Oct 82

INSTITUTO DE PESQUISAS ESPACIAIS
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CHAPTER 1

INTRODUCTION

1.1 DOCUMENT PURPOSE

This document defines the format of the computer compatible tapes (CCT) which contain Thematic Mapper (TM) imagery data acquired from the Landsat D and D Prime satellites by the INSTITUTO DE PESQUISAS ESPACIAIS (CNPq-INPE/BRAZIL).

The INPE Landsat TM CCT product format is based on the "LGSOWG CCT format CCB document : The standard CCT family of tape formats." This standard was developed by the CANADA CENTRE FOR REMOTE SENSING and it is being used as a reference by the Landsat Technical Working Group. The main objective of this standard is to allow the easy interchange of data from various remote sensing sources, and in particular, the international interchange of LANDSAT imagery data.

1.2 DOCUMENT ORGANIZATION

Chapter 2 describes the physical and logical organization of the INPE Landsat TM CCT product, accordingly to processing options like interleaving format, number of spectral bands, tape density etc.

Chapter 3 presents an overview of the superstructure concepts used in the definition of the CCT format. In addition it presents the CCT files and describes all record types that compose the product.

Appendix A presents the detailed description of the record types, field by field, necessary for the complete understanding of the format.

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CHAPTER 2

INPE LANDSAT TM PRODUCT DESCRIPTION

2.1 PRODUCT DEFINITION

The standard Landsat TM Product consists in a full or a quadrant of a scene recorded in 800 bpi NRZI or 1600 bpi phase encoded tapes. Up to seven TM spectral bands may be requested.

A full scene is composed by 386 sweeps of video data such that the 194th sweep is the one which scans the WRS frame center.

Radiometric corrections may be applied, under user request, to calibrate or to enhance the video data.

The video data are shifted by an integer number of pixels to perform the alignment between video lines. Reverse scans are inverted to nominally register the forward scans. Thermal band data are replicated four times within the line and the lines are also replicated four times such that all bands will have the same number of pixels and lines. Geometric modelling matrices are also included in the CCT to help, if desired, further geometric corrections to be applied.

2.1.1 SCENE DEFINITION BY QUADRANTS

A scene shall be divided into four quadrants such that :

- Quadrant 1 contains the upper right quarter of the scene.
- Quadrant 2 contains the upper left quarter of the scene.
- Quadrant 3 contains the lower left quarter of the scene.
- Quadrant 4 contains the lower right quarter of the scene.

Assuming that :

- Pixel number 1 is band 1 first pixel .
- each full line contains 6304 image pixels.
- band offsets, in pixels, are :

Band 1 - 0 pixels
 Band 2 - 25 pixels
 Band 3 - 50 pixels
 Band 4 - 75 pixels
 Band 5 - 146 pixels
 Band 6 - 183 pixels
 Band 7 - 120 pixels

If the alignment of the bands is performed, a full line shall contain the 6304 image pixels plus the the maximum band offset which is 183 pixels. So, an aligned video line is defined as having 6487 pixels and the first useful pixel of band 1 is the pixel 1, the first useful pixel of band 2 is the pixel 26 and so on.

As the scene has 386 sweeps and each sweep has 16 lines, the scene center is placed in pixel 3245, line 3089, which is the uppermost and leftmost pixel of quadrant 4. There is no overlap between quadrants.

Table 2.1 presents the complete definition of the quadrants.

Quadrant	First pixel	Last pixel	First line	Last line
1	3245	6487	1	3088
2	1	3244	1	3088
3	1	3244	3089	6176
4	3245	6487	3089	6176

Table 2.1
Quadrant Definition

2.1.2 FULL FRAME DEFINITION

Due to space limitation in magnetic tapes, when generating full frame scenes, all the pixels which are not sampled by all detectors will be discarded. This means that every full line, containing 6304 pixels, will be shortened by 183 pixels. So, each recorded line will contain 6121 pixels and all lines will be aligned across bands. The number of discarded pixels at the beginning of a line is given by the value 183 minus the respective band offset; and the number of discarded pixels at the end of the line is given by the respective band offset.

2.2 PRODUCT ORGANIZATION

INPE Landsat TM CCT products are organized into logical volumes, which can be split over one or more physical volumes (tapes). The number of physical volumes depends on the number of requested spectral bands, the tape density and the size of the scene (full frame or quadrant). A logical volume contains header, ancillary, annotation, image data and trailer information for a scene, and all these data are organized into the following files, defined by the superstructure concepts :

- Volume directory file
- Header file
- Imagery file
- Trailer file
- Null volume directory file

The video organization may be Band Sequential (BSQ) or Band Interleaved by Line (BIL). In the BSQ format the video data of one spectral band are sequentially written in one imagery file such that there are as many imagery files as the number of spectral bands. In the BIL format the video data for all requested spectral bands of one scan line are recorded sequentially before starting the next scan line. All the scene is recorded as just one imagery file.

The volume directory file contains information about the distribution of the other files among the physical volumes that compose a logical volume.

The header file provides auxiliary data related to the recorded scene.

The null volume directory file is a subset of the volume directory file and appears at the end of the logical volume.

Figures 2.1 through 2.8 present the logical volume organization depending on tape density and scene size. Although the number of spectral bands is always 7 in these examples, any number of bands may be present in the logical volume, according to the user request.

```

+-----+
| VOLUME DIRECTORY FILE |
|-----EOF-----|
|   HEADER FILE   |
|-----EOF-----|
| BAND 1 IMAGE FILE |
|-----EOF-----|
| BAND 2 IMAGE FILE |
|   (partial)   |
|-----EOF-----|
+-----+

```

Physical volume #1

```

+-----+
| VOLUME DIRECTORY FILE |
|-----EOF-----|
| BAND 2 IMAGE FILE |
|   (continuation)   |
|-----EOF-----|
| BAND 3 IMAGE FILE |
|-----EOF-----|
+-----+

```

Physical volume #2

```

+-----+
| VOLUME DIRECTORY FILE |
|-----EOF-----|
| BAND 4 IMAGE FILE |
|-----EOF-----|
| BAND 5 IMAGE FILE |
|   (partial)   |
|-----EOF-----|
+-----+

```

Physical volume #3

```

+-----+
| VOLUME DIRECTORY FILE |
|-----EOF-----|
| BAND 5 IMAGE FILE |
|   (continuation)   |
|-----EOF-----|
| BAND 6 IMAGE FILE |
|-----EOF-----|
+-----+

```

Physical volume #4

```

+-----+
| VOLUME DIRECTORY FILE |
|-----EOF-----|
| BAND 7 IMAGE FILE |
|-----EOF-----|
| NULL VOLUME DIRECTORY |
|-----EOF-----|
|-----EOF-----|
+-----+

```

Physical volume #5

Figure 2.1
BSQ/800 bpi/quadrant CCT layout

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```
+-----+
| VOLUME DIRECTORY FILE |
|-----EOF-----|
|   HEADER FILE         |
|-----EOF-----|
|   BAND 1 IMAGE FILE   |
|-----EOF-----|
|   BAND 2 IMAGE FILE   |
|-----EOF-----|
|   BAND 3 IMAGE FILE   |
|-----EOF-----|
+-----EOF-----+
```

Physical volume #1

```
+-----+
| VOLUME DIRECTORY FILE |
|-----EOF-----|
|   BAND 4 IMAGE FILE   |
|-----EOF-----|
|   BAND 5 IMAGE FILE   |
|-----EOF-----|
|   BAND 6 IMAGE FILE   |
|-----EOF-----|
+-----EOF-----+
```

Physical volume #2

```
+-----+
| VOLUME DIRECTORY FILE |
|-----EOF-----|
|   BAND 7 IMAGE FILE   |
|-----EOF-----|
| NULL VOLUME DIRECTORY |
|-----EOF-----|
|-----EOF-----|
+-----EOF-----+
```

Physical volume #3

Figure 2.2
BSQ/1600 bpi/quadrant CCT layout

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```
+-----+
| VOLUME DIRECTORY FILE |
|-----EOF-----|
|   HEADER FILE         |
|-----EOF-----|
|   IMAGE FILE          |
|   (partial)           |
|-----EOF-----|
|-----EOF-----|
+-----+
```

Physical volume #1

```
+-----+
| VOLUME DIRECTORY FILE |
|-----EOF-----|
|   IMAGE FILE          |
|   (continuation)      |
|-----EOF-----|
|-----EOF-----|
+-----+
```

Physical volume #3

```
+-----+
| VOLUME DIRECTORY FILE |
|-----EOF-----|
|   IMAGE FILE          |
|   (continuation)      |
|-----EOF-----|
| NULL VOLUME DIRECTORY |
|-----EOF-----|
|-----EOF-----|
|-----EOF-----|
+-----+
```

Physical volume #5

```
+-----+
| VOLUME DIRECTORY FILE |
|-----EOF-----|
|   IMAGE FILE          |
|   (continuation)      |
|-----EOF-----|
|-----EOF-----|
+-----+
```

Physical volume #2

```
+-----+
| VOLUME DIRECTORY FILE |
|-----EOF-----|
|   IMAGE FILE          |
|   (continuation)      |
|-----EOF-----|
|-----EOF-----|
+-----+
```

Physical volume #4

Figure 2.3
BIL/800 bpi/quadrant CCT layout

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```
+-----+
| VOLUME DIRECTORY FILE |
|-----EOF-----|
|   HEADER FILE         |
|-----EOF-----|
|   IMAGE FILE           |
|   (partial)            |
|-----EOF-----|
+-----EOF-----+
```

Physical volume #1

```
+-----+
| VOLUME DIRECTORY FILE |
|-----EOF-----|
|   IMAGE FILE           |
|   (continuation)       |
|-----EOF-----|
+-----EOF-----+
```

Physical volume #2

```
+-----+
| VOLUME DIRECTORY FILE |
|-----EOF-----|
|   IMAGE FILE           |
|   (continuation)       |
|-----EOF-----|
| NULL VOLUME DIRECTORY |
|-----EOF-----|
|-----EOF-----|
+-----EOF-----+
```

Physical volume #3

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```
+-----+
! VOLUME DIRECTORY FILE !
!-----EOF-----!
!   HEADER FILE       !
!-----EOF-----!
!   BAND 1 IMAGE FILE  !
!       (partial)     !
!-----EOF-----!
+-----EOF-----+
```

Physical volume #1

```
+-----+
! VOLUME DIRECTORY FILE !
!-----EOF-----!
!   BAND 1 IMAGE FILE  !
!       (continuation) !
!-----EOF-----!
+-----EOF-----+
```

Physical volume #2

```
+-----+
! VOLUME DIRECTORY FILE !
!-----EOF-----!
!   BAND 2 IMAGE FILE  !
!       (partial)     !
!-----EOF-----!
+-----EOF-----+
```

Physical volume #3

```
+-----+
! VOLUME DIRECTORY FILE !
!-----EOF-----!
!   BAND 2 IMAGE FILE  !
!       (continuation) !
!-----EOF-----!
+-----EOF-----+
```

Physical volume #4

```
.      .      .      .
.      .      .      .
.      .      .      .
```

```
.      .      .      .
.      .      .      .
.      .      .      .
```

```
+-----+
! VOLUME DIRECTORY FILE !
!-----EOF-----!
!   BAND 7 IMAGE FILE  !
!       (partial)     !
!-----EOF-----!
+-----EOF-----+
```

Physical volume #13

```
+-----+
! VOLUME DIRECTORY FILE !
!-----EOF-----!
!   BAND 7 IMAGE FILE  !
!       (continuation) !
!-----EOF-----!
! NULL VOLUME DIRECTORY !
!-----EOF-----!
!-----EOF-----!
+-----EOF-----+
```

Physical volume #14

Figure 2.5
BSQ/800 bpi/full frame CCT layout

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```
+-----+
| VOLUME DIRECTORY FILE |
|-----EOF-----|
|   HEADER FILE         |
|-----EOF-----|
|   BAND 1 IMAGE FILE   |
|-----EOF-----|
+-----EOF-----+
```

Physical volume #1

```
+-----+
| VOLUME DIRECTORY FILE |
|-----EOF-----|
|   BAND 7 IMAGE FILE   |
|-----EOF-----|
| NULL VOLUME DIRECTORY |
|-----EOF-----|
|-----EOF-----|
+-----EOF-----+
```

Physical volume #7

```
+-----+
| VOLUME DIRECTORY FILE |
|-----EOF-----|
|   BAND 4 IMAGE FILE   |
|-----EOF-----|
+-----EOF-----+
```

Physical volume #2

```
+-----+
| VOLUME DIRECTORY FILE |
|-----EOF-----|
|   BAND 4 IMAGE FILE   |
|-----EOF-----|
+-----EOF-----+
```

Figure 2.6
BSQ/1600 b2i/full frame CCT layout

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```
+-----+
! VOLUME DIRECTORY FILE !
!-----EOF-----!
!   HEADER FILE       !
!-----EOF-----!
!   IMAGE FILE        !
!   (partial)         !
!-----EOF-----!
!-----EOF-----!
```

Physical volume #1

```
:   :   :   :
:   :   :   :
:   :   :   :
```

```
+-----+
! VOLUME DIRECTORY FILE !
!-----EOF-----!
!   IMAGE FILE          !
!   (continuation)     !
!-----EOF-----!
! NULL VOLUME DIRECTORY !
!-----EOF-----!
!-----EOF-----!
!-----EOF-----!
```

Physical volume #14

```
+-----+
! VOLUME DIRECTORY FILE !
!-----EOF-----!
!   IMAGE FILE          !
!   (continuation)     !
!-----EOF-----!
!-----EOF-----!
```

Physical volume #2

```
:   :   :   :
:   :   :   :
:   :   :   :
```

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```

+-----+
| VOLUME DIRECTORY FILE |
|-----EOF-----|
|     HEADER FILE      |
|-----EOF-----|
|     IMAGE FILE       |
|     (partial)        |
|-----EOF-----|
+-----EOF-----+

```

Physical volume #1

```

.   .   .   .
.   .   .   .
.   .   .   .

```

```

+-----+
| VOLUME DIRECTORY FILE |
|-----EOF-----|
|     IMAGE FILE       |
|     (continuation)   |
|-----EOF-----|
| NULL VOLUME DIRECTORY |
|-----EOF-----|
|-----EOF-----|
+-----EOF-----+

```

Physical volume #7

```

+-----+
| VOLUME DIRECTORY FILE |
|-----EOF-----|
|     IMAGE FILE       |
|     (continuation)   |
|-----EOF-----|
+-----EOF-----+

```

Physical volume #2

```

.   .   .   .
.   .   .   .
.   .   .   .

```

CHAPTER 3

INPE LANDSAT TM CCT FORMAT DEFINITION

3.1 SUPERSTRUCTURE CONCEPTS OVERVIEW

The standard format family is based on superstructure concepts which comprises four distinct hierarchical levels of data organization : volume, file, record and data field level. A group of files compose a logical volume which may be stored in several physical volumes (tapes) and a physical volume may store several logical volumes.

The two basic components of the superstructure are the volume directory file and the file descriptor record.

At the highest level, a logical volume is introduced by the volume directory file which identifies and defines the logical volume. It is the first file recorded on a volume and is composed by a volume descriptor record, file pointer records (one for each following data file) and optionally a text record. The end of a set of logical volumes is marked by a null volume directory file. This file is composed by an updated volume descriptor record.

Besides these superstructure files, there are three data file classes :

CLASS NAME	CLASS CODE	FILE CONTENT
HEADER FILE	HEAD	scene related information
IMAGERY FILE	IMGY	image data
TRAILER FILE	TRAI	trailer data

The file descriptor record is the first record within each data file and it defines the internal structure of the file providing parameters to interpret its content. It is separated into two segments, a fixed segment and a variable segment. The fixed segment format is predefined by the superstructure and contains the file number, class and name, and specifies the location and format of the introductory information (sequence number, type codes and record length) within the data records. The variable segment format is unique for each file class, and contains information concerning the content of the file. When a file is split between tapes, the file descriptor record appears only once

at the beginning of the file.

Within each record, the first six fields are generally used to specify the record sequence number, the record type code and sub-type codes (3 sub-types) and the record length. These fields are always stored in binary and constitute what is called the record identification segment.

3.2 INPE LANDSAT TM CCT FILES

3.2.1 VOLUME DIRECTORY FILE

The volume directory is the first file of every INPE LANDSAT TM physical volume. It consists of a text record, volume descriptor record and file pointer records.

3.2.1.1 TEXT RECORD - This record appears only in the first volume directory file of a logical volume. It contains general information about the product, under an easily readable format. Tape and scene identification, time and date of creation, are for instance part of the information.

3.2.1.2 VOLUME DESCRIPTOR RECORD - The volume descriptor record is separated into five segments, which are the record identification, superstructure documentation identification, volume identification, a spare segment and a local use segment. It contains all information about the identification and organization of the logical volume, such as the number of physical volumes in this logical volume, identification of the current physical volume and the product identification. In addition, it specifies the number of data files in the logical volume.

Some fields of this record are updated whenever a new physical volume is initiated in order to reflect the actual state of the logical volume. When there is no text record in the volume, the volume descriptor is the first record of the volume.

3.2.1.3 FILE POINTER RECORD - This record points to a specific file in the logical volume. For each file within the logical volume there is one file pointer record. It is separated into four segments: the record identification, file identification, a spare segment and a local use segment.

The file identification consists of the file number, name and class, file data type and type code, number of records within the file, record length and length type, and file location within the logical volume.

3.2.2 HEADER FILE

This file is the second one in a logical volume, it comes just after the volume directory file. It supplies useful information associated with the scene, like Payload Correction Data (PCD), processed ephemeris data, radiometric data, geometric modelling data and detailed scene identification.

3.2.2.1 HEADER FILE DESCRIPTOR RECORD - This is the first record in the header file and its variable segment gives the number and length of all types of records contained within the file. In addition, it supplies locators to important fields which permit their precise localization within the file.

Locators for the header file are sixteen bytes long with the following format :

BYTES	CONTENT
1-6	sequence number of the record containing the field
7-12	byte number of first byte of field
13-15	length of the field in bytes
16	type of data in the field : A - alphanumeric (ASCII or EBCDIC) B - binary N - numeric (ASCII or EBCDIC)

3.2.2.2 INTERVAL RELATED DATA RECORD - This record shall contain information about the interval of the revolution recorded by the receiving station, like the start and stop time of PCD and imagery data acquisition time span. One interval related data record is provided on CCT.

3.2.2.3 TM HOUSEKEEPING DATA RECORD - This record contains the processed TM housekeeping telemetry data contained in one telemetry (TLM) major frame, i.e., in the third PCD major frame after the telemetry major frame pulse (one TLM major frame comprises four PCD major frames). These data consist in a set of temperatures, supplied every 16.384 secs. Since the start times of the PCD major frame do not coincide with the image major frame start times, two or three records will be necessary to span one scene.

3.2.2.4 EPHEMERIS AND ATTITUDE DATA RECORD - This record contains all the ephemeris and attitude data, gyro data and gyro drift data from one TLM major frame. It comprises four sets of attitude data (one set per PCD major frame), two sets of ephemeris data (one set every two PCD major frames), four sets of gyro data (one set comprises 64 three axis measurements sampled every 64 milliseconds), and one set of gyro drift data. Two or three records are required to encompass one scene.

3.2.2.5 RAW JITTER MEASUREMENTS DATA RECORD - This record contains the raw jitter measurements obtained from the three-axis angle displacement sensor (ADS) during a period of 2.048 secs, which corresponds to a half PCD major frame time period. The jitter magnitude can be measured by the ADS in the frequency range 2 to 125 Hz and each axis is sampled every 2 milliseconds.

3.2.2.6 PROCESSED EPHEMERIS DATA RECORD - This record contains processed ephemeris data calculated for every 1 sec of imagery data. 29 three-axis position and velocity values are supplied in one record, along with the coordinates of nadir.

3.2.2.7 SCENE HEADER RECORD - The scene header record contains the mission identification, the input scene identification, the quadrant identification, the sensor parameters and the processing options.

3.2.2.8 MAP PROJECTION DATA RECORD - This record contains geometric characteristics of the scene and includes the basic parameters for the UTM and SDM map projections.

3.2.2.9 RADIOMETRIC ELEMENTS RECORD - The radiometric elements record contains processed radiometric data necessary when performing an absolute calibration. These data consist in radiance limits for each spectral bands, the radiance seen by the detectors at each calibration state and the processed calibration samples acquired during the interval (mean and variance).

3.2.2.10 RADIOMETRIC CALIBRATION DATA RECORD - This record contains the look up tables assigned for one particular spectral band. there will be as many records as spectral bands requested. If the imagery data is raw video data, the LUT's must be applied to calibrate the video. If the imagery data is calibrated video, the LUT's are those used to calibrate the video. If the imagery data

is a radiometrically processed special product, the LUT's are those used to 'special' process the calibrated video. In addition, an offset and a gain coefficients are supplied to allow transformation of the calibrated video gray levels into radiance values.

3.2.2.11 GEOMETRIC MODELLING DATA RECORD - This record contains 18 breakpoints for a specific sweep, where each breakpoint is related to a pixel number and gives the latitude and longitude for this particular pixel, nominally placed between the 8th and 9th line of the sweep. Depending on processing conditions (geometric level), 25 or 386 records are supplied. By interpolation, the user would be able to derive the latitude and longitude coordinates of any pixel.

3.2.2.12 ANNOTATION RECORD - This record contains alphanumeric information about the scene and the tick mark data. These data correspond to the annotation present in INPE photographic products.

3.2.3 IMAGERY FILE

The imagery file contains the video data of one spectral band in BSR format or it contains the video of all requested bands in BIL format. Each record within the file comprises the video data and some support data such scan time, scan line number and quality codes. The support data may appear at the beginning of the record, where it is called prefix data, or at the end, where it is called suffix data.

The first record of this file is the file descriptor record, which contains information about the image data records.

3.2.3.1 IMAGERY FILE DESCRIPTOR RECORD - This is the first record in the imagery file and its variable segment gives the number and length of the records contained within the file, the organization of the pixels within a group of bytes, the organization of multispectral lines within the records and other important information about the data organization. In addition, it supplies locators to important fields which permit their precise localization within the record.

Locators for the imagery file are eight bytes long with the following format :

BYTES

CONTENT

1-4 first byte number of the field, within prefix or suffix.

- 5-6 length of the field in bytes
- 7 indicator to field location :
 P - field is in prefix
 S - field is in suffix
- 8 type of data in the field :
 A - alphanumeric (ASCII or EBCDIC)
 B - binary
 N - numeric (ASCII or EBCDIC)

3.2.3.2 IMAGE DATA RECORD - This record contains scan lines image data, prefix and suffix data and the standard introductory data. The record length depends on the size of the image, if it is a full frame image or a quadrant image.

3.2.4 NULL VOLUME DIRECTORY FILE

The null volume directory file is the end of set of volumes marker. It comes after the last imagery file of the logical volume. It comprises an updated volume descriptor record.

3.2.4.1 VOLUME DESCRIPTOR RECORD - This record is basically the volume descriptor record that appears in the volume directory file, but several fields are now blank filled.

3.2.5 SUMMARY OF FILES AND RECORDS

VOLUME DIRECTORY FILE

Record Name	Record Length	Record Type T	S1	S2	S3
Text record	360	077	022	022	022
Volume descriptor	360	300	300	022	022
File pointer	360	300	333	022	022

HEADER FILE

Record Name	Record Length	Record Type (octal) T	S1	S2	S3
File descriptor	540	300	077	022	022
Interval related data	360	022	111	111	022
TM housekeeping data	360	044	177	111	022
Ephem. attitude data	3960	044	366	111	022
Raw Jitter measurements	6300	044		111	022
Processed ephemeris	2340	044	366	222	022
Scene header	1440	022	022	022	022
Map projection data	1800	044	044	022	022
Radiometric elements	2160	044	077	111	022
Radiometric calibration	4140	044	077	022	022
Geometric modelling	360	044	044	222	022
Annotation data	540	333	022	022	022

IMAGERY FILE (full frame)

Record Name	Record Length	Record Type (octal) T	S1	S2	S3
File descriptor	6300	300	077	022	022
Image data	6300	355	355	333	022

IMAGERY FILE (by quadrant)

Record Name	Record Length	Record Type (octal) T	S1	S2	S3
File descriptor	3600	300	077	022	022
Image data	3600	355	355	333	022

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INPE LANDSAT TM CCY FORMAT DEFINITION

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NULL VOLUME DIRECTORY FILE

Record Name	Record Length	T	Record Type S1	S2	S3
Volume descriptor	360	300	300	077	022

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APPENDIX A

INPE LANDSAT TM CCT FILES FORMAT LAYOUT

This appendix presents the layout of all records defined in the preceding chapters.

The data specified in the layouts have the following data types :

- A - alphanumeric coded in ASCII
- N - numeric coded in ASCII
- B - binary

A string of alphanumeric data represented in ASCII is always left justified and blank filled on the right and a string of numeric data is right justified and blank filled at left. An ASCII character occupies the low order seven bits of a byte and the eighth bit is zero.

The binary data is represented in the following formats, compatible with DEC VAX 11/780 data representation :

- Byte - One byte unsigned integer (8 bits)
- Integer*2 - Single precision integer (16 bits)
- Integer*4 - Double precision integer (32 bits)
- Real*4 - Single precision floating point (32 bits)
- Real*8 - Double precision floating point (64 bits)

In the layouts, each field may be located within the record by the columns POS and SIZE. POS indicates the number of the first byte of the field within the record (first byte is byte 1), and SIZE indicates the field size in bytes.

By default, a binary data with no format specification in the layout is an integer*n data, where n is the size of the field (Integer*1 = Byte).

VOLUME DIRECTORY FILE

A.1 VOLUME DIRECTORY FILE

A.1.1 TEXT RECORD

Seq	Field description	Type	Pos	Size	Unit	Format or value
1	Record sequence number	B	1	4		
2	Sub type code #1	B	5	1		022(B)
3	Type code	B	6	1		077(B)
4	Sub type code #2	B	7	1		022(B)
5	Sub type code #3	B	8	1		022(B)
6	Location of this record	B	9	4		360
7	ASCII/EBDIC flag	A	13	2		A\$
8	Blanks					
9	Product type	A	15	2		\$
10	Carriage return / line feed	A	17	48		PRODUCT\$
11	Location and date/time of creation	A	65	2		\$LANDSAT\$TH\$BIL\$RAW
		A	67	64		<CR><LF>
						PROCESS\$
						SIRASILSCHPO\$INPE\$
						OUT\$SDO-MMM-YYYY\$
						AT\$HH:MM:SS.MM
						CR<LF>
12	Carriage return / line feed	A	131	2		IMAGER\$SDO-MMM-YYYY
13	Acquisition date	A	133	32		CR<LF>
14	Carriage return / line feed	A	165	2		SCHEMATIC IDENTIFICATIONS:
15	Scene center time	A	167	40		\$TIME\$HHMMSS.T
						CR<LF>
16	Carriage return / line feed	A	207	2		QUAD\$MM\$N
17	Quadrant	A	209	16		CR<LF>
18	Carriage return / line feed	A	225	2		BAND\$31234567
19	Sands processed	A	227	16		CR<LF>
20	Carriage return / line feed	A	243	2		WPC\$SPPT-KRR
21	WGS location	A	245	40		\$SCENING\$OUT\$OF\$GRID
22	Carriage return / line feed	A	285	2		LAT/LONG\$
23	Center coordinates	A	287	32		CR<LF>
24	Carriage return / line feed	A	319	2		\$SDR:MM:SS/MD:MM:SS
25	Blanks	A	321	40		CR<LF>

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VOLUME DIRECTORY FILE
VOLUME DESCRIPTOR RECORD

A.1.2 VOLUME DESCRIPTOR RECORD

Seq	Field description	Type	Pos	Size	Unit	Format or value
1	Record sequence number	R	1	4		
2	Sub type code #1	R	5	1		300(B)
3	Type code	R	6	1		300(S)
4	Sub type code #2	R	7	1		22(B)
5	Sub type code #3	R	8	1		22(B)
6	Length of this record	S	9	4		360
7	ASCII/ERCUIC flag	A	13	2		A
8	2 Blanks	A	15	2		\$
9	Superstructure control document ID	A	17	12		CCB-CCI-0002
10	Superstructure control document revision number	A	29	2		\$C
11	Superstructure record format revision letter number	A	31	2		\$A
12	Software Release Number	A	33	12		TRD
13	File ID of current physical volume	A	45	16		YYDDHH-RRRR/NN
14	Logical Volume ID	A	61	16		YYDDHHHHSS.I
15	Volume Set ID	A	77	16		LANDSAT\$4\$TH\$
16	Number of tapes on logical volume	N	93	2		FORTRAN 12 format
17	First physical volume of logical volume	N	95	2		11
18	Last physical volume of logical volume	N	97	2		FORTRAN 12 format
19	Current Physical Volume number	N	99	2		FORTRAN 12 format
20	First file number in this physical volume	N	401	4		FORTRAN 14 format
21	Logical volume number within volume set	N	105	4		FORTRAN 14 format
22	Logical volume number within physical volume	A	109	4		\$
23	Logical volume creation date	A	113	8		YYYYMMDD
24	Logical volume creation time	A	121	8		HHMMSSXX
25	Logical volume generation country	A	129	12		BRASIL\$
26	Logical volume generation agency	A	141	8		CRPOLMPE
27	Logical volume generation facility	A	149	12		UGI\$
28	Number of file pointers in volume directory	N	161	4		FORTRAN 14 format
29	Number of records in volume directory	N	165	4		FORTRAN 14 format
30	Volume spare segment	A	169	92		BLANKS
	Local Use Segment					
	Scene identification					
31	Instrument	A	261	2		TH
32	Satellite	A	263	1		4 or 5
33	Separator	A	264	1		-
34	Revolution	N	265	5		FORTRAN 15.5 format
35	Separator	A	270	1		-
36	Row	N	271	3		FORTRAN 13.3 format
37	Separator	A	274	1		-
38	Type of run	A	275	1		C
39	Number of the run	N	276	3		FORTRAN 13 format

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VOLUME DIRECTORY FILE
VOLUME DESCRIPTOR RECORD

! Seq !	Field description	! Type !	Pos !	Size !	Unit !	Format or value
40	Separator	A	279	1		-
41	Quadrant number	N	280	1		FORTAN I1 format
42	Separator	A	281	1		-
43	Interleaving indicator	A	282	3		PIL or BSO
44	Separator	A	285	1		-
45	Processed bands	A	286	7		one character per band
46	Blank					
47	Instrument	A	293	1		TH
48	Satellite	A	294	2		4 or 5
49	Scene center size	A	296	1		YYDDHHMMSSHHMMFF
50	URS designation	A	297	16		
51	Path number	N	313	3		FORTAN I3 format
52	Orbital direction	A	315	1		A or D
53	Row number	N	317	3		FORTAN I3 format
54	Out of URS grid indicator	A	320	1		+ if out of grid, blank oth
55	Acquisition date	A	321	8		YYY/MM/DD
56	GMT acquisition time	A	329	8		HHMMSSXX
57	Blank					
58	TYPE processing type	A	337	1		HDC,CDC ...
59	Scene center latitude	A	338	3		NNNN:MM:SS or SDDD:MM:SS
60	Scene center longitude	A	341	10		EDDD:MM:SS or WDDD:MM:SS
61	Blank					
62	Blank					
63	Blank					
64	Blank					
65	Blank					
66	Blank					
67	Blank					
68	Blank					
69	Blank					
70	Blank					
71	Blank					
72	Blank					
73	Blank					
74	Blank					
75	Blank					
76	Blank					
77	Blank					
78	Blank					
79	Blank					
80	Blank					
81	Blank					
82	Blank					
83	Blank					
84	Blank					
85	Blank					
86	Blank					
87	Blank					
88	Blank					
89	Blank					
90	Blank					
91	Blank					
92	Blank					
93	Blank					
94	Blank					
95	Blank					
96	Blank					
97	Blank					
98	Blank					
99	Blank					
100	Blank					

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VOLUME DIRECTORY FILE
FILE POINTER RECORD

A.1.3 FILE POINTER RECORD

Seq	Field description	Type	Pos	Size	Unit	Format or value
1	Record sequence number	B	1	4		
2	Sub type code #1	B	5	1		33(8)
3	Type code	B	6	1		300(8)
4	Sub type code #2	B	7	1		22(8)
5	Sub type code #3	B	8	1		22(8)
6	Length of this record	B	9	4		360
7	ASCII/EBCDIC flag	A	13	2		4
8	2 Right	A	15	2		4
9	Referenced file number (position after volume directory)	N	17	4		FORTRAN 14 format
10	Referenced file name	A	21	16		HEADER FILE
						LSATHSRKIMGYS\$SON
						LSATHSRKIMGYS\$RILs
11	Referenced file class	A	37	28		HEADER
12	Referenced file class Code	A	65	4		IMRBERY
						HEAD
						IMCY
13	Referenced file data type	A	69	28		MIXEDBINARYANDASCII
14	Referenced file data type class	A	97	4		HRAN
15	Number of records in file	N	101	8		FORTRAN 18 format
16	Referenced file descriptor record length	N	109	8		FORTRAN 18 format
17	Referenced file maximum record length	N	117	8		FORTRAN 18 format
18	Referenced file record length type	A	125	12		FIXEDLENGTH
						VARIABLE\$LEN
19	Referenced file record length type code	A	137	4		FIXD
						VARC
20	Physical volume containing first referenced file record	N	141	2		FORTRAN 12 format
21	Physical volume containing last referenced file record	N	143	2		FORTRAN 12 format
22	Referenced file first record in this physical volume	N	145	8		FORTRAN 18 format
23	Pointer Space Segment	A	153	108		
24	Zero Fill	A	261	100		

HEADER FILE
HEADER FILE

A.2 HEADER FILE

A.2.1 HEADER FILE DESCRIPTOR RECORD

Seq	Field description	Type	Pos	Size	Unit	Format or value
FILE DESCRIPTOR FIXED SEGMENT						
1	Record sequence number	B	1	4		
2	Sub type code #1	B	5	1		077(8)
3	Type code	B	4	1		300(8)
4	Sub type code #2	B	7	1		022(8)
5	Sub type code #3	B	8	1		022(8)
6	Length of this record	B	9	4		540
7	ASCII/EBCDIC Flag	A	13	2		A5
8	2 blanks	A	15	2		55
9	Superstructure control document	A	17	12		TRD
10	Revision number	A	29	2		SA
11	Revision letter number	A	31	2		SA
12	Software release number	A	33	12		TRD
13	Info file number within logical volume	N	45	4		FORTSAN I4 format
14	File name	A	49	16		HEMUR FILE
15	Record sequence and location type flag	A	65	4		PSEN
16	Sequence number location	A	69	8		\$\$\$\$\$\$1
17	Sequence number field length	A	77	4		\$\$\$
18	Record code and location type flag	A	81	4		FTYP
19	Record code location	A	85	4		\$\$\$
20	Record code field length	A	89	4		\$\$\$
21	Record length and location type flag	A	93	4		FLGT
22	Record length location	A	97	8		\$\$\$\$\$\$9
23	Record length field length	A	105	8		\$\$\$
24	Flag indicating whether data interpretation information is included in the file descriptor record	A	113	1		Y
25	Flag indicating whether data interpretation information is included in records other than file descriptor	A	114	1		N
26	Flag indicating whether data display information is included in the file descriptor record	A	115	1		N
27	Flag indicating whether data display information is included in records other than file descriptor	A	116	1		N
28	Reserved segment	A	117	64		
FILE DESCRIPTOR VARIABLE SEGMENT						
29	Number of interval related records	N	181	6		FORTSAN I6 format
30	Interval related record length	N	187	6		FORTSAN I6 format
31	Number of TH housekeeping records	N	193	6		FORTSAN I6 format
32	TH housekeeping record length	N	199	6		FORTSAN I6 format

HEADER FILE
HEADER FILE DESCRIPTOR RECORD

Seq	Field description	Type	Pos	Size	Unit	Format or value
33	Number of ephemeris and attitude records	N	205	6		FORTAN 16 format
34	Ephemeris and attitude record length	N	211	6		FORTAN 16 format
35	Number of raw jitter measurements records	N	217	6		FORTAN 16 format
36	Raw jitter measurements record length	N	223	6		FORTAN 16 format
37	Number of processed ephemeris records	N	229	6		FORTAN 16 format
38	Processed ephemeris record length	N	235	6		FORTAN 16 format
39	Number of scene header records	N	241	6		FORTAN 16 format
40	Scene header record length	N	247	6		FORTAN 16 format
41	Number of map projection records	N	253	6		FORTAN 16 format
42	Map projection record length	N	259	6		FORTAN 16 format
43	Number of radiometric elements records	N	265	6		FORTAN 16 format
44	Radiometric elements record length	N	271	6		FORTAN 16 format
45	Number of radiometric calibration records	N	277	6		FORTAN 16 format
46	Radiometric calibration record length	N	283	6		FORTAN 16 format
47	Number of geometric modelling data records	N	289	6		FORTAN 16 format
48	Geometric modelling data record length	N	295	6		FORTAN 16 format
49	Number of annotation data records	N	301	6		FORTAN 16 format
50	Annotation data record length	N	307	6		FORTAN 16 format
	Locator format :					
	where :					
	hhhhhh - scene header record sequence number					
	bbbbb - number of first byte in field					
	lll - field length in bytes					
	t - type of data : A, B or N					
51	Scene identification field locator	A	313	16		hhhhhh000067016A
52	MKS identification field locator	A	329	16		hhhhhh000179008N
53	Mission identification field locator	A	345	16		hhhhhh000613016A
54	Sensor identification field locator	A	361	16		hhhhhh000029016A
55	Scene center date-time field locator	A	377	16		hhhhhh000143016A
56	Geographic reference field locator	A	393	16		hhhhhh000227024A
57	Image processing field locator	A	409	16		hhhhhh000419096A
58	Imagery interleaving format field locator	A	425	16		hhhhhh000515016A
59	Processed bands field locator	A	441	16		hhhhhh0009411008N

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HEADER FILE
HEADER FILE DESCRIPTOR RECORD

Seq	Field description	Type	Pos	Size	Unit	Format or value
60	Quadrant field locator	A	457	16		hhhhhh00026001A
61	Blanks	A	473	68		

HEADER FILE
INTERVAL RELATED DATA RECORD

A.2.2 INTERVAL RELATED DATA RECORD

Seq	Field description	Type	Pos	Size	Unit	Format or value
1	Record Sequence Number	B	1	4		
2	Sub Type Code #1	B	5	1		111(8)
3	Type Code	B	6	1		022(8)
4	Sub Type Code #2	B	7	1		111(8)
5	Sub Type Code #3	B	8	1		022(8)
6	Length of this Record	B	9	4		360
7	Mission number	A	13	2		L4 or L5
8	Data source	A	15	4		NASA or ERGS
9	Input scene start time	A	19	16		YYDDHHMMSSMMHHFF
10	Input scene stop time	A	35	16		YYDDHHMMSSMMHHFF
11	PCD telemetry start time	A	51	16		YYDDHHMMSSMMHHFF
12	PCD telemetry stop time	A	67	16		YYDDHHMMSSMMHHFF
13	Number of recorded PCD major frames	N	93	8		FORTIAN 18 format
14	Number of recorded TLM frames	N	99	8		FORTIAN 18 format
15	Orbit number	N	104	1		FORTIAN 15 format
16	Orbital direction	A	105	1		A or D
17	BLANKS			256		

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HEADER FILE
TM HOUSEKEEPING DATA RECORD

A.2.3 TM HOUSEKEEPING DATA RECORD

Seq	Field description	Type	Pos	Size	Unit	Format or value
1	Record Sequence Number	B	1	4		
2	Sub Type Code #1	B	5	1		177(8)
3	Type Code	B	6	1		044(8)
4	Sub Type Code #2	B	7	1		111(8)
5	Sub Type Code #3	B	8	1		022(8)
6	Length of this Record	B	9	4		360
7	Observation time	A	13	16		YYDDHHMMSSHHMMFF
8	Blackbody temperature	N	29	8	Kelvin	FORTAN F8.2 format
9	Silicon FPA temperature	N	37	8	Kelvin	FORTAN F8.2 format
10	Cal shutter fies temperature	N	45	8	Kelvin	FORTAN F8.2 format
11	SPARE	A	53	8		
12	Raffle temperature	N	61	8	Kelvin	FORTAN F8.2 format
13	Cold FPA monitor temperature	N	69	8	Kelvin	FORTAN F8.2 format
14	SPARE	A	77	8		
15	SPARE	A	85	8		
16	Scan line corrector temperature	N	93	8	Kelvin	FORTAN F8.2 format
17	Cal shutter hub temperature	N	101	8	Kelvin	FORTAN F8.2 format
18	SPARE	A	109	8		
19	SPARE	A	117	8		
20	Relay optics temperature	N	125	8	Kelvin	FORTAN F8.2 format
21	SPARE	A	133	8		
22	SPARE	A	141	8		
TM HOUSEKEEPING SERIAL WORDS						
each word is 8 bits long and each bit is represented in this format by one character						
23	Serial word A	A	149	8		
24	Serial word B	A	157	8		
25	Serial word C	A	165	8		
26	Serial word D	A	173	8		
27	Serial word E	A	181	8		
28	Serial word F	A	189	8		
29	Serial word G	A	197	8		
30	Serial word H	A	205	8		
31	Serial word L	A	213	8		
32	Primary mirror temperature	N	221	8	Kelvin	FORTAN F8.2 format
33	SPARE	A	229	8		
34	Secondary mirror temperature	N	237	8	Kelvin	FORTAN F8.2 format
35	SPARE	A	245	8		
36	SPARE	A	253	8		

TM HOUSEKEEPING DATA RECORD

HEADER FILE

Seq	Field description	Type	Pos	Size	Unit	Format or value
37	SPARE	A	261	8		
38	SPARE	A	269	8		
39	SPARE	A	277	8		
40	BLANKS	A	285	76		

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HEADER FILE
EPHEMERIS AND ATTITUDE DATA RECORD

A.2.4 EPHEMERIS AND ATTITUDE DATA RECORD

Seq	Field description	Type	Pos	Size	Unit	Format or value
1	Record sequence number	B	1	4		366(8)
2	Sub type code #1	B	5	1		044(8)
3	Type code	B	6	1		111(8)
4	Sub type code #2	B	7	1		022(8)
5	Sub type code #3	B	8	1		3980
6	Length of this record	B	9	4		YYDDHHMMSSMMHHFF
7	ILM frame start time	A	13	16		
8	EPHEMERIS DATA SET #1					
9	Measurement time offset	N	29	10	microsec	FORTRAN I10 format
10	X position component	N	39	22	meter	FORTRAN D22.15 format
11	Y position component	N	61	22	meter	FORTRAN D22.15 format
12	Z position component	N	83	22	meter	FORTRAN D22.15 format
13	X velocity component	N	105	22	m/msec	FORTRAN D22.15 format
14	Y velocity component	N	127	22	m/msec	FORTRAN D22.15 format
15	Z velocity component	N	149	22	m/msec	FORTRAN D22.15 format
16	EPHEMERIS DATA SET #2					
17	Measurement time offset	N	171	10	microsec	FORTRAN I10
18	X position component	N	191	22	meter	FORTRAN D22.15 format
19	Y position component	N	203	22	meter	FORTRAN D22.15 format
20	Z position component	N	225	22	meter	FORTRAN D22.15 format
21	X velocity component	N	247	22	m/msec	FORTRAN D22.15 format
22	Y velocity component	N	269	22	m/msec	FORTRAN D22.15 format
23	Z velocity component	N	291	22	m/msec	FORTRAN D22.15 format
24	ATTITUDE DATA SET #1					
25	Measurement time offset	N	313	10	microsec	FORTRAN I10
26	EPA1	N	323	22		FORTRAN D22.15 format
27	EPA2	N	345	22		FORTRAN D22.15 format
28	EPA3	N	367	22		FORTRAN D22.15 format
29	EPA4	N	389	22		FORTRAN D22.15 format
30	ATTITUDE DATA SET #2					
31	Measurement time offset	N	411	10	microsec	FORTRAN I10
32	EPA1	N	421	22		FORTRAN D22.15 format
33	EPA2	N	443	22		FORTRAN D22.15 format
34	EPA3	N	465	22		FORTRAN D22.15 format
35	EPA4	N	487	22		FORTRAN D22.15 format

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HEADER FILE
EPHEMERIS AND ATTITUDE DATA RECORD

Seq	Field description	Type	Pos	Size	Unit	Format or value
	ATTITUDE DATA SET #3					
32	Measurement time offset					
33	EP#1	N	509	10	microsecs	FORTAN I10
34	EP#2	N	519	22		FORTAN D22.15 format
35	EP#3	N	541	22		FORTAN D22.15 format
36	EP#4	N	563	22		FORTAN D22.15 format
	ATTITUDE DATA SET #4					
37	Measurement time offset					
38	EP#1	N	607	10	microsecs	FORTAN I10
39	EP#2	N	617	22		FORTAN D22.15 format
40	EP#3	N	639	22		FORTAN D22.15 format
41	EP#4	N	661	22		FORTAN D22.15 format
	GYRO DATA SET #1					
42	First measurement time offset					
43	X axis measurement	N	705	10	microsecs	FORTAN I10
44	Y axis measurement	R	715	4	radians	Real#4
45	Z axis measurement	R	719	4	radians	Real#4
	The following 63 measurements have the same format as defined above					
46	63 X,Y and Z measurements set	R	723	4	radians	Real#4
	GYRO DATA SET #2					
47	First measurement time offset					
48	X axis measurement	N	1493	10	microsecs	FORTAN I10 format
49	Y axis measurement	R	1497	4	radians	binary data
50	Z axis measurement	R	1501	4	radians	binary data
	The following 63 measurements have the same format as defined above					
51	63 X,Y and Z measurements set	R	1505	756	radians	Real#4
	GYRO DATA SET #3					
52	First measurement time offset	N	2261	10	microsecs	FORTAN I10 format

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EPHEMERIS AND ATTITUDE DATA RECORD

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Seq	Field description	Type	Pos	Size	Unit	Format or value
53	X axis measurement	B	2271	4	radians	Real*4
54	Y axis measurement	B	2275	4	radians	Real*4
55	Z axis measurement	B	2279	4	radians	Real*4
	The following 63 measurements have the same format as defined above					
56	63 X,Y and Z measurements set	B	2283	756	radians	Real*4
	GYRO DATA SET #4					
57	First measurement time offset	N	3039	10	microsecs	FORTAN I10 format
58	X axis measurement	B	3049	4	radians	Real*4
59	Y axis measurement	B	3053	4	radians	Real*4
60	Z axis measurement	B	3057	4	radians	Real*4
	The following 63 measurements have the same format as defined above					
61	63 X,Y and Z measurements set	B	3061	756	radians	Real*4
	GYRO DRIFT DATA					
62	Measurement time offset	N	3817	10	microsecs	FORTAN I10 format
63	X axis measurement	B	3827	4	radians	Real*4
64	Y axis measurement	B	3831	4	radians	Real*4
65	Z axis measurement	B	3835	4	radians	Real*4
66	BLANKS	A	3839	122		

HEADER FILE
RAW JITTER MEASUREMENTS DATA RECORD

A.2.5 RAW JITTER MEASUREMENTS DATA RECORD

Seq	Field description	Type	Pos	Size	Unit	Format or value
1	Record sequence number	B	1	4		
2	Sub type code #1	B	5	1		544(8)
3	Type code	B	6	1		044(8)
4	Sub type code #2	B	7	1		111(8)
5	Sub type code #3	B	8	1		022(8)
6	Length of this record	B	9	4		6300
7	TLM frame start time	A	13	16		YYDDHHMMSSMMHHFF
	Temperature data					
8	ADS temperature time offset	N	29	10	microsecs	FORTAN I10 format
9	ADS temperature	N	39	8	Centigrade	FORTAN F8.4 format
10	ADS temperature time offset	N	47	10	microsecs	FORTAN I10 format
11	ADS temperature	N	57	8	Centigrade	FORTAN F8.4 format
12	ADS temperature time offset	N	65	10	microsecs	FORTAN I10 format
13	ADS temperature	N	75	8	Centigrade	FORTAN F8.4 format
14	ADS temperature time offset	N	83	10	microsecs	FORTAN I10 format
15	ADS temperature	N	93	8	Centigrade	FORTAN F8.4 format
	ADS first measurement time offset					
16	Axis 1 first ADS measurement time offset	N	101	10	microsecs	FORTAN I10 format
17	Axis 2 first ADS measurement time offset	N	111	10	microsecs	FORTAN I10 format
18	Axis 3 first ADS measurement time offset	N	121	10	microsecs	FORTAN I10 format
	LSR of ADS measurement is (250/2**11) microradian					
	ADS first measurements					
19	Axis 1 measurement	B	131	2		Integer#2
20	Axis 2 measurement	B	133	2		Integer#2
21	Axis 3 measurement	B	135	2		Integer#2
	The time offset between 2 samples of the same axis is 2 milliseconds					
22	1023 next ADS measurements as defined above	B	137	6086		Integer#2
23	BLANKS	A	6233	78		

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HEADER FILE
PROCESSED EPHEMERIS DATA RECORD

A.2.6 PROCESSED EPHEMERIS DATA RECORD

Seq	Field description	Type	Pos	Size	Unit	Format or value
1	Record sequence number	B	1	4		
2	Sub type code #1	B	5	1		366(8)
3	Type code	B	6	1		044(8)
4	Sub type code #2	B	7	1		222(8)
5	Sub type code #3	B	8	1		022(8)
6	Length of this record	B	9	4		2340
7	Observation time	A	13	16		YYDDHHMMSSHHMMFF
8	Nadir latitude	B	29	8	radians	Real#8
9	Nadir longitude	B	37	8	radians	Real#8
10	X position	B	45	8	kilometer	Real#8
11	Y position	B	53	8	kilometer	Real#8
12	Z position	B	61	8	kilometer	Real#8
13	X velocity	B	69	8	km/sec	Real#8
14	Y velocity	B	77	8	km/sec	Real#8
15	Z velocity	B	85	8	km/sec	Real#8
28 subs of ephemeris data following the format as defined above :						
Observation time						
Nadir latitude						
Nadir longitude						
X position						
Y position						
Z position						
X velocity						
Y velocity						
Z velocity						
16	28 ephemeris data set	B	93	2240		Real#8
17	Blanks	A	2333	8		

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HEADER FILE
SCENE HEADER RECORD

A.2.7 SCENE HEADER RECORD

Seq	Field description	Type	Pos	Size	Unit	Format or value
1	Record sequence number					
2	Sub type code #1	B	1	4		022(8)
3	Type code	B	5	1		022(8)
4	Sub type code #2	B	6	1		022(8)
5	Sub type code #3	B	7	1		022(8)
6	Length of this record	B	8	1		022(8)
		B	9	4		1440
	Mission parameters					
7	Mission identification	A	13	16		LANDSAT-4 or LANDSAT-5
8	Instrument identification	A	29	16		TH
9	Orbit number	N	45	5		FORTAN 15 format
10	Orbital direction	A	50	1		A or B
	Input scene parameters					
11	Product identification	A	51	16		INFE=LATNCTCTRAW
12	Input scene identification	A	67	16		IMAYDDDDHHHSS.T
13	Input scene center latitude	A	83	12		SUN:HH:SS
14	Input scene center longitude	A	95	12		WDD:HH:SS
15	Line number at input scene center	N	107	6		FORTAN 16 format
16	Pixel number at input scene center	N	113	6		FORTAN 16 format
17	First pixel of input scene	N	119	6		FORTAN 16 format
18	Last pixel of input scene	N	125	6		FORTAN 16 format
19	First line of input scene	N	131	6		FORTAN 16 format
20	Last line of input scene	N	137	6		FORTAN 16 format
21	Input scene center time	A	143	16		YYDDHHHSSHHHF
22	Time offset from WRS frame	N	159	4	seconds	FORTAN F4.1 format
23	Latitude offset from WRS nominal position	N	163	8	degree	FORTAN F8.4 format
24	Longitude offset from WRS nominal position	N	171	8	degree	FORTAN F8.4 format
25	Path number	N	179	4		FORTAN 14 format
26	Row number	N	183	4		FORTAN 14 format
27	WRS orbital cycle since launch	N	187	8		FORTAN 18 format
28	Sun elevation at input scene center	N	195	8	degree	FORTAN F8.3 format
29	Sun azimuth at input scene center	N	203	8	degree	FORTAN F8.3 format
	Processed scene parameters (quadrant n)					
30	Processed scene identification	A	211	16		IMAYDDDDHHHSS/n
31	Processed scene center latitude	A	227	12		SUN:HH:SS
32	Processed scene center longitude	A	239	12		WDD:HH:SS
33	Line number at processed scene center	N	251	6		FORTAN 16 format
34	Pixel number at processed scene center	N	257	6		FORTAN 16 format
	Processed scene coordinates related to input scene					

HEADER FILE
SCENE HEADER RECORD

Seq	Field description	Type	Pos	Size	Unit	Format or value
35	First pixel of processed scene	N	263	6		FORTAN 16 format
36	Last pixel of processed scene	N	269	6		FORTAN 16 format
37	First line of processed scene	N	275	6		FORTAN 16 format
38	Last line of processed scene	N	281	6		FORTAN 16 format
39	Number of scene pixels per line	N	287	6		FORTAN 16 format
40	Number of lines in processed scene	N	293	6		FORTAN 16 format
	Sensor Parameters					
41	Band 1 upper wavelength limit	N	299	8	nanometer	FORTAN 18 format
42	Band 1 lower wavelength limit	N	307	8	nanometer	FORTAN 18 format
43	Band 2 upper wavelength limit	N	315	8	nanometer	FORTAN 18 format
44	Band 2 lower wavelength limit	N	323	8	nanometer	FORTAN 18 format
45	Band 3 upper wavelength limit	N	331	8	nanometer	FORTAN 18 format
46	Band 3 lower wavelength limit	N	339	8	nanometer	FORTAN 18 format
47	Band 4 upper wavelength limit	N	347	8	nanometer	FORTAN 18 format
48	Band 4 lower wavelength limit	N	355	8	nanometer	FORTAN 18 format
49	Band 5 upper wavelength limit	N	363	8	nanometer	FORTAN 18 format
50	Band 5 lower wavelength limit	N	371	8	nanometer	FORTAN 18 format
51	Band 6 upper wavelength limit	N	379	8	nanometer	FORTAN 18 format
52	Band 6 lower wavelength limit	N	387	8	nanometer	FORTAN 18 format
53	Band 7 upper wavelength limit	N	395	8	nanometer	FORTAN 18 format
54	Band 7 lower wavelength limit	N	403	8	nanometer	FORTAN 18 format
	Processing Parameters					
55	Processed bands identification	A	411	8		H1234567 N - number of bands
56	Radiometric calibration designator	A	419	16		8
57	Number of bits per pixel	A	435	16		
58	Radiometric correction designator	A	451	16		
59	Geometric correction designator	A	467	16		
60	Resampling designator	A	483	16		
61	Map Projection Identifier	A	499	16		
62	Interleaving indicator	A	515	16		
63	Detector replacement array	N	531	400		BIL or RSD FORTAN 100(14) format
64	Detector smoothing array	N	931	100		FORTAN 100(41) format
65	Forward	N	1031	96		FORTAN 6E16.9 format
66	Reverse	N	1127	96		FORTAN 6E16.9 format
67	Blanks	A	1223	218		

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HEADER FILE
MAP PROJECTION DATA RECORD

A-2.8 MAP PROJECTION DATA RECORD

Seq	Field description	Type	Pos	Size	Unit	Format or value
1	Record sequence number	B	1	4		
2	Sub type code #1	B	5	1		044(8)
3	Type code	B	6	1		044(8)
4	Sub type code #2	B	7	1		022(8)
5	Sub type code #3	B	8	1		022(8)
6	Length of this record	B	9	4		1800
7	Ellipsoid major semi-axis	N	13	16	meter	FORTAN I16 format
8	Ellipsoid minor semi-axis	N	29	16	meter	FORTAN I16 format
	Input scene - full frame					
	Processed scene - quadrant					
	Input scene related data					
9	Nominal pixels per line number					
10	Nominal lines per scene number	N	45	8		FORTAN I8 format
11	Nominal inter-pixel distance at nadir	N	53	8		FORTAN I8 format
12	Nominal inter-line distance at nadir	N	61	8	meter	FORTAN I8 format
13	Input scene related data	N	69	8	meter	FORTAN I8 format
	UTM related data					
14	UTM zone number	N	77	8	degree	FORTAN F8.2 format
15	Nominal WRS northing of center	N	85	8		FORTAN I8 format
16	Nominal WRS easting of center	N	93	16	meter	FORTAN I16 format
17	Northing of scene center	N	109	16	meter	FORTAN I16 format
18	Easting of scene center	N	125	16	meter	FORTAN I16 format
19	Vertical drift of scene center to WRS nominal center	N	141	16	meter	FORTAN I16 format
20	Horizontal drift of scene center to WRS nominal center	N	157	16	meter	FORTAN I16 format
21	Orientation of center	N	173	16	meter	FORTAN I16 format
	SOM related data					
22	Nominal WRS X coordinate of center	N	189	8	degree	FORTAN F8.2 format
23	Nominal WRS Y coordinate of center	N	197	16	meter	FORTAN I16 format
24	X coordinate of scene center	N	213	16	meter	FORTAN I16 format
25	Y coordinate of scene center	N	229	16	meter	FORTAN I16 format
26	Vertical drift of scene center to WRS nominal center	N	245	16	meter	FORTAN I16 format
27	Horizontal drift of scene center to WRS nominal center	N	261	16	meter	FORTAN I16 format
28	Orientation of center	N	277	16	meter	FORTAN I16 format
29	Processed scene related data	N	293	8	degree	FORTAN F8.2 format
	Nominal pixels per line number					
30	Nominal lines per scene number	N	301	8		FORTAN I8 format
31	Nominal inter-pixel distance at nadir	N	309	8		FORTAN I8 format
32	Nominal inter-line distance at nadir	N	317	16	meter	FORTAN I16 format
		N	333	16	meter	FORTAN I16 format

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MAP PROJECTION DATA RECORD

! Seq !	Field description	! Type !	Pos !	Size !	Unit	Format or value
33	UTM zone number	N	349	8		FORTAN I8 format
34	Line number at WRS center	N	357	8		FORTAN I8 format
35	Pixel number at WRS center	N	365	8		FORTAN I8 format
36	Orientation of center	N	373	8	degree	FORTAN F8.2 format
37	Nominal satellite inclination	N	381	8	degree	FORTAN F8.2 format
38	Nominal ascending node longitude at equator	N	389	8	degree	FORTAN F8.2 format
39	Nominal satellite altitude	N	397	16	meter	FORTAN I16 format
40	Nominal ground speed	N	413	16	meter/sec	FORTAN I16 format
41	Satellite heading including earth rotation	N	429	8	degree	FORTAN F8.2 format
42	Angle of drift at WRS center	N	437	8	degree	FORTAN F8.2 format
43	Cross-track field of view	N	445	8	degree	FORTAN F8.2 format
44	Sensor scan rate	N	453	16	scan/sec	FORTAN F16.4 format
45	Sensor active sampling rate	N	459	16	sample/sec	FORTAN F16.4 format
46	Zero fill	A	485	1316		

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HEADER FILE
RADIOMETRIC ELEMENTS RECORD

A.2.9 RADIOMETRIC ELEMENTS RECORD

Seq	Field description	Type	Pos	Size	Unit	Format or value
1	Record sequence number	B	1	4		
2	Sub type code #1	B	5	1		077(8)
3	Type code	B	6	1		044(8)
4	Sub type code	B	7	1		111(8)
5	Sub type code #3	B	8	1		022(8)
6	Length of this record	B	9	4		2160
	Radiance limits					
	FAIN - 0 level					
	FAHX - 255 level					
7	Maximum radiance for band 1	N	13	8	mW/cm2/sr	FORTRAN F8.3 format
8	Maximum radiance for band 2	N	21	8	mW/cm2/sr	FORTRAN F8.3 format
9	Maximum radiance for band 3	N	29	8	mW/cm2/sr	FORTRAN F8.3 format
10	Maximum radiance for band 4	N	37	8	mW/cm2/sr	FORTRAN F8.3 format
11	Maximum radiance for band 5	N	45	8	mW/cm2/sr	FORTRAN F8.3 format
12	Maximum radiance for band 7	N	53	8	mW/cm2/sr	FORTRAN F8.3 format
13	Maximum temperature for band 6	N	61	8	Kelvin	FORTRAN F8.3 format
14	Minimum radiance for band 1	N	69	8	mW/cm2/sr	FORTRAN F8.3 format
15	Minimum radiance for band 2	N	77	8	mW/cm2/sr	FORTRAN F8.3 format
16	Minimum radiance for band 3	N	85	8	mW/cm2/sr	FORTRAN F8.3 format
17	Minimum radiance for band 4	N	93	8	mW/cm2/sr	FORTRAN F8.3 format
18	Minimum radiance for band 5	N	101	8	mW/cm2/sr	FORTRAN F8.3 format
19	Minimum radiance for band 7	N	109	8	mW/cm2/sr	FORTRAN F8.3 format
20	Minimum temperature for band 6	N	117	8	Kelvin	FORTRAN F8.3 format
21	Radiance of band 1 calibration states	N	125	64	mW/cm2.sr	FORTRAN 8(F8.3) format
22	Radiance of band 2 calibration states	N	189	64	mW/cm2.sr	FORTRAN 8(F8.3) format
23	Radiance of band 3 calibration states	N	255	64	mW/cm2.sr	FORTRAN 8(F8.3) format
24	Radiance of band 4 calibration states	N	317	64	mW/cm2.sr	FORTRAN 8(F8.3) format
25	Radiance of band 5 calibration states	N	381	64	mW/cm2.sr	FORTRAN 8(F8.3) format
26	Radiance of band 7 calibration states	N	445	64	mW/cm2.sr	FORTRAN 8(F8.3) format
27	Blackbody temperature	N	509	8	Kelvin	FORTRAN F8.3 format
28	Shutter surface temperature	N	517	8	Kelvin	FORTRAN F8.3 format
29	Number of samples per detector per state	N	525	4		FORTRAN I4 format
	Band 1 calibration samples					
30	Det 1 cal samples	B	529	8		Byte
31	Det 2 cal samples	B	537	8		Byte
32	Det 3 cal samples	B	545	8		Byte
33	Det 4 cal samples	B	553	8		Byte

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RADIOMETRIC ELEMENTS RECORD

Seq	Field description	Type	Pos	Size	Unit	Format or value
34	Det 5 cal samples	B	561	8		Byte
35	Det 6 cal samples	B	569	8		Byte
36	Det 7 cal samples	B	577	8		Byte
37	Det 8 cal samples	B	585	8		Byte
38	Det 9 cal samples	B	593	8		Byte
39	Det 10 cal samples	B	601	8		Byte
40	Det 11 cal samples	B	609	8		Byte
41	Det 12 cal samples	B	617	8		Byte
42	Det 13 cal samples	B	625	8		Byte
43	Det 14 cal samples	B	633	8		Byte
44	Det 15 cal samples	B	641	8		Byte
45	Det 16 cal samples	B	649	8		Byte
	For the next bands the format is the same as defined for band 1					
46	Band 2 calibration samples	B	657	128		Byte
47	Band 3 calibration samples	B	785	128		Byte
48	Band 4 calibration samples	B	913	128		Byte
49	Band 5 calibration samples	B	1041	128		Byte
50	Band 7 calibration samples	B	1169	128		Byte
	Band 6 calibration samples					
51	Det 1 blackbody sample	B	1297	1		Byte
52	Det 1 shutter surface sample	B	1298	1		Byte
53	Det 2 blackbody sample	B	1299	1		Byte
54	Det 2 shutter surface sample	B	1300	1		Byte
55	Det 3 blackbody sample	B	1301	1		Byte
56	Det 3 shutter surface sample	B	1302	1		Byte
57	Det 4 blackbody sample	B	1303	1		Byte
58	Det 4 shutter surface sample	B	1304	1		Byte
	Band 1 calibration samples variance					
59	Det 1 calibration sample variance	B	1305	8		Byte
60	Det 2 calibration sample variance	B	1313	8		Byte
61	Det 3 calibration sample variance	B	1321	8		Byte
62	Det 4 calibration sample variance	B	1329	8		Byte
63	Det 5 calibration sample variance	B	1337	8		Byte

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RADIOMETRIC ELEMENTS RECORD

Seq	Field description	Type	Pos	Size	Unit	Format or value
64	Det 6 calibration sample variance	B	1345	8		Byte
65	Det 7 calibration sample variance	B	1353	8		Byte
66	Det 8 calibration sample variance	B	1361	8		Byte
67	Det 9 calibration sample variance	B	1369	8		Byte
68	Det 10 calibration sample variance	B	1377	8		Byte
69	Det 11 calibration sample variance	B	1385	8		Byte
70	Det 12 calibration sample variance	B	1393	8		Byte
71	Det 13 calibration sample variance	B	1401	8		Byte
72	Det 14 calibration sample variance	B	1409	8		Byte
73	Det 15 calibration sample variance	B	1417	8		Byte
74	Det 16 calibration sample variance	B	1425	8		Byte
75	Band 2 calibration samples variance	B	1433	128		Byte
76	Band 3 calibration samples variance	B	1561	128		Byte
77	Band 4 calibration samples variance	B	1689	128		Byte
78	Band 5 calibration samples variance	B	1817	128		Byte
79	Band 7 calibration samples variance	B	1945	128		Byte
80	Band 6 calibration samples variance					
81	Det 1 blackbody samples variance	B	2073	1		Byte
82	Det 2 shutter surface sample variance	B	2074	1		Byte
83	Det 2 blackbody samples variance	B	2075	1		Byte
84	Det 2 shutter surface sample variance	B	2076	1		Byte
85	Det 3 blackbody samples variance	B	2077	1		Byte
86	Det 3 shutter surface sample variance	B	2078	1		Byte
87	Det 4 blackbody samples variance	B	2079	1		Byte
87	Det 4 shutter surface sample variance	B	2080	1		Byte
88	Blanks	A	2081	80		

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HEADER FILE
RADIOMETRIC CALIBRATION DATA RECORD

A.2.10 RADIOMETRIC CALIBRATION DATA RECORD

Seq	Field description	Type	Pos	Size	Unit	Format or value
1	Record sequence number	R	1	4		
2	Sub type code #1	B	5	1		077(8)
3	Type code	B	6	1		044(8)
4	Sub type code #2	B	7	1		022(8)
5	Sub type code #3	B	8	1		022(8)
6	Length of this record	B	9	4		4140
7	Band number	B	13	4		Integer*4
8	Lower reflectance limit	R	17	4	mW/cm2/sr	Real*4
9	Upper reflectance limit	B	21	4	mW/cm2/sr	Real*4
10	Equalizing reference det	B	25	4		Integer*4
Radiance = Gray level x A1 + A0						
11	Offset coefficient (A0)	R	29	4	mW/cm2/sr	Real*4
12	Gain coefficient (A1)	B	33	4	mW/cm2/sr	Real*4
13	Det 1 look up table data	N	37	256		Byte
14	Det 2 look up table data	N	293	256		Byte
15	Det 3 look up table data	N	549	256		Byte
16	Det 4 look up table data	N	805	256		Byte
17	Det 5 look up table data	N	1061	256		Byte
18	Det 6 look up table data	N	1317	256		Byte
19	Det 7 look up table data	N	1573	256		Byte
20	Det 8 look up table data	N	1829	256		Byte
21	Det 9 look up table data	N	2085	256		Byte
22	Det 10 look up table data	N	2341	256		Byte
23	Det 11 look up table data	N	2597	256		Byte
24	Det 12 look up table data	N	2853	256		Byte
25	Det 13 look up table data	N	3109	256		Byte
26	Det 14 look up table data	N	3365	256		Byte
27	Det 15 look up table data	N	3621	256		Byte
28	Det 16 look up table data	N	3877	256		Byte
29	BLANKS	A	4133	8		

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HEADER FILE
GEOMETRIC MODELLING DATA RECORD

A.2.1.1 GEOMETRIC MODELLING DATA RECORD

Seq	Field description	Type	Pos	Size	Unit	Format or value
1	Record sequence number	B	1	4		
2	Sub type code #1	B	5	1		044(8)
3	Type code	B	6	1		044(8)
4	Sub type code #2	B	7	1		222(8)
5	Sub type code #3	B	8	1		022(8)
6	Length of this record	B	9	4		360
7	Sweep number	B	13	4		Integer*4
8	Sweep direction (0 - forward 1 - reverse)	B	17	1		Byte
9	Sweep start time	A	18	16		YYDDHHNNSSHHMMFF
10	Breakpoint 1 related data					
11	Pixel number within sweep	B	34	4		Integer*4
12	Latitude	B	38	4	10**8 rad	Integer*4
13	Longitude	B	42	4	10**8 rad	Integer*4
14	Breakpoint 2 related data					
15	Pixel number within sweep	B	46	4		Integer*4
16	Latitude	B	50	4	10**8 rad	Integer*4
17	Longitude	B	54	4	10**8 rad	Integer*4
18	Breakpoint 3 related data					
19	Pixel number within sweep	B	58	4		Integer*4
20	Latitude	B	62	4	10**8 rad	Integer*4
21	Longitude	B	66	4	10**8 rad	Integer*4
22	Breakpoint 4 related data					
23	Pixel number within sweep	B	70	4		Integer*4
24	Latitude	B	74	4	10**8 rad	Integer*4
25	Longitude	B	78	4	10**8 rad	Integer*4
26	Breakpoint 5 related data					
27	Pixel number within sweep	B	82	4		Integer*4
28	Latitude	B	86	4	10**8 rad	Integer*4
29	Longitude	B	90	4	10**8 rad	Integer*4
30	Breakpoint 6 related data					
31	Pixel number within sweep	B	94	4		Integer*4
32	Latitude	B	98	4	10**8 rad	Integer*4
33	Longitude	B	102	4	10**8 rad	Integer*4
34	Breakpoint 7 related data					
35	Pixel number within sweep	B	106	4		Integer*4
36	Latitude	B	110	4	10**8 rad	Integer*4

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HEADER FILE
GEOMETRIC MODELLING DATA RECORD

Seq	Field description	Type	Pos	Size	Unit	Format or value
30	Longitude	B	114	4	10**-8 rad	Integer*4
31	Breakpoint 8 related data					
32	Pixel number within sweep	B	118	4		Integer*4
33	Latitude	B	122	4	10**-8 rad	Integer*4
34	Longitude	B	126	4	10**-8 rad	Integer*4
35	Breakpoint 9 related data					
36	Pixel number within sweep	B	130	4		Integer*4
37	Latitude	B	134	4	10**-8 rad	Integer*4
38	Longitude	B	138	4	10**-8 rad	Integer*4
39	Breakpoint 10 related data					
40	Pixel number within sweep	B	142	4		Integer*4
41	Latitude	B	146	4	10**-8 rad	Integer*4
42	Longitude	B	150	4	10**-8 rad	Integer*4
43	Breakpoint 11 related data					
44	Pixel number within sweep	B	154	4		Integer*4
45	Latitude	B	158	4	10**-8 rad	Integer*4
46	Longitude	B	162	4	10**-8 rad	Integer*4
47	Breakpoint 12 related data					
48	Pixel number within sweep	B	166	4		Integer*4
49	Latitude	B	170	4	10**-8 rad	Integer*4
50	Longitude	B	174	4	10**-8 rad	Integer*4
51	Breakpoint 13 related data					
52	Pixel number within sweep	B	178	4		Integer*4
53	Latitude	B	182	4	10**-8 rad	Integer*4
54	Longitude	B	186	4	10**-8 rad	Integer*4
55	Breakpoint 14 related data					
56	Pixel number within sweep	B	190	4		Integer*4
57	Latitude	B	194	4	10**-8 rad	Integer*4
58	Longitude	B	198	4	10**-8 rad	Integer*4
59	Breakpoint 15 related data					
60	Pixel number within sweep	B	202	4		Integer*4
61	Latitude	B	206	4	10**-8 rad	Integer*4
62	Longitude	B	210	4	10**-8 rad	Integer*4
63	Breakpoint 16 related data					
64	Pixel number within sweep	B	214	4		Integer*4

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HEADER FILE
GEOMETRIC MODELLING DATA RECORD

Seq	Field description	Type	Pos	Size	Unit	Format or value
56	Latitude	B	213	4	10*-8 rad	Integer*4
57	Longitude	B	222	4	10*-8 rad	Integer*4
58	Breakpoint 17 related data					
59	Pixel number within sweep	B	226	4		Integer*4
60	Latitude	B	230	4	10*-8 rad	Integer*4
61	Longitude	B	234	4	10*-8 rad	Integer*4
62	Breakpoint 18 related data					
63	Pixel number within sweep	B	239	4		Integer*4
64	Latitude	B	242	4	10*-8 rad	Integer*4
65	Longitude	B	246	4	10*-8 rad	Integer*4
66	BLANKS	A	250	111		

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HEADER FILE
ANNOTATION DATA RECORD

A.2.12 ANNOTATION DATA RECORD

Seq	Field description	Type	Pos	Size	Unit	Format or value
1	Record sequence number	B	1	4		
2	Sub type code #1	B	5	1		022(B)
3	Type code	B	6	1		333(B)
4	Sub type code #2	B	7	1		222(B)
5	Sub type code #3	B	8	1		022(B)
6	Length of this record	B	9	4		540
7	URS path and row identifier					
8	URS path number	A	13	3		001 - 233
9	URS row number	A	16	1		A or B
10	Out of URS grid indicator	A	17	3		001 - 245
11	Blanks	A	20	1		+ or blank
12	Date of image acquisition					
13	Day of month	A	24	2		01 - 31
14	Month	A	26	3		JAN - DEC
15	Year	A	29	2		82 - 99
16	Blanks	A	31	2		
17	Latitude and longitude of the center					
18	Fixed	A	23	2		C:
19	Position	A	35	1		N or S
20	Degrees latitude	A	36	2		DD
21	Fixed	A	38	1		:
22	Minutes latitude	A	39	2		MM
23	Fixed	A	41	1		/
24	Position	A	42	1		E or W
25	Degrees longitude	A	43	3		DDD
26	Fixed	A	46	1		:
27	Minutes longitude	A	47	2		MM
28	Blanks	A	49	3		
29	Mission and sensor identifier					
30	Sensor	A	52	2		TH
31	Fixed	A	54	3		3--
32	Satellite	A	57	8		LANDSATs
33	Mission number	A	65	1		4 or 5
34	Blanks	A	66	3		
35	Sum position					
36	Fixed	A	69	5		SOL:s
37	Fixed	A	74	2		EL
38	Sun elevation	A	76	2		DD

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HEADER FILE
ANNOTATION DATA RECORD

Seq	Field description	Type	Pos	Size	Unit	Format or value
35	Fixed	A	78	3		\$AZ
36	Sun azimuth	A	81	3		000
	Satellite heading					
37	Fixed	A	84	2		\$
38	Fixed	A	86	1		R
39	Heading	A	87	3	degree	000
	Scene center time					
40	Fixed	A	90	7		\$\$\$T/C\$
41	Scene center time	A	97	14		YYDDD-HHHSS.T
	Geometric characteristics					
42	Type of map projection	A	111	3		SOM or UTM
43	Blank	A	114	1		G=N
44	Geometric level (0 -> 7)	A	115	3		E=N
45	Blank	A	118	1		
46	Ephemeris type (0 -> 7)	A	119	3		
47	Blank	A	122	1		
48	Resampling algorithm	A	123	3		
49	Blank	A	126	1		
50	Image size	A	127	9		mmXmm
51	Blank	A	136	2		
	WGS nominal coordinates					
52	Fixed	A	138	2		W:\$
53	Position	A	140	1		N or S
54	Degrees latitude	A	141	2		00
55	Fixed	A	143	1		:
56	Minutes latitude	A	144	2		MM
57	Fixed	A	146	1		/
58	Position	A	147	1		E or W
59	Degrees longitude	A	148	3		000
60	Fixed	A	151	1		:
61	Minutes longitude	A	152	2		MM
62	Blank	A	154	2		
	Radiometric characteristics					
63	Fixed	A	156	8		16NDA(S)
64	Processed bands	A	164	7		1234567
65	Thermal band indicator	A	171	1		x or blank
66	Blank	A	172	2		
67	Radiometric level (0 -> 3)	A	174	3		R=N
68	Blank	A	177	1		
69	Sun elevation correction indicator	A	178	3		CES or blank

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HEADER FILE
ANNOTATION DATA RECORD

Seq	Field description	Type	Pos	Size	Unit	Format or value
70	Blank	A	181	1		
71	Gamma indicator	A	182	7		GAMA=\$N
72	Blanks	A	189	3		
73	Recording quality	A	191	5		00 - 99
74	Blanks	A	193	3		
75	Processing date and time					
75	Fixed	A	199	5		PROCS
76	Date of Processing	A	204	7		DDMMYY
77	Blank	A	211	1		
78	Time of Processing	A	212	5		HH:MM
79	UTM zone on precision products	A	217	11		ZONA\$UTMSNN
80	Quadrant identification					
80	Quadrant number	A	228	11		QUAD\$ANTE=N (0 -> 9)
81	Fixed	A	239	2		O:\$
82	Position	A	241	1		N or S
83	Degrees latitude	A	242	2		DD
84	Fixed	A	244	1		:
85	Minutes latitude	A	245	2		MM
86	Fixed	A	247	1		/
87	Position	A	249	1		E or W
88	Degrees longitude	A	249	3		DDD
89	Fixed	A	252	1		:
90	Minutes longitude	A	253	2		MM
91	Blanks	A	255	30		
92	Thermal band warning	A	285	7		*TERRAL
93	Blanks	A	292	2		
94	Processing type	A	294	3		CDE
95	Treatments	A	297	18		TRAT(S):AAAAAAAAA
96	Country and agency identification	A	315	18		\$BRASIL-CNFO/INPE\$
97	Identification of the original	A	333	16		TM4-12345-S001
98	Upper border tick marks					
98	Tick mark					
98	Line number	B	349	2		Intersect
99	Pixel number	B	351	2		Intersect2
100	Position	A	353	1		E (east) or W (west)
101	Longitude	A	354	6		DDD-MM

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HEADER FILE
ANNOTATION DATA RECORD

Seq	Field description	Type	Pos	Size	Unit	Format or value
102	Tick mark 2 data					
103	Line number	B	360	2		Integer*2
104	Pixel number	B	362	2		Integer*2
105	Position	A	364	1		E (east) or W (west)
106	Longitude	A	365	6		DDD-HH
107	Tick mark 3 data					
108	Line number	B	371	2		Integer*2
109	Pixel number	B	373	2		Integer*2
110	Position	A	375	1		E (east) or W (west)
111	Longitude	A	376	6		DDD-HH
112	Tick mark 4 data					
113	Line number	B	382	2		Integer*2
114	Pixel number	B	384	2		Integer*2
115	Position	A	386	1		E (east) or W (west)
116	Longitude	A	387	6		DDD-HH
117	Lower border tick marks					
118	Tick mark 1 data					
119	Line number	B	393	2		Integer*2
120	Pixel number	B	395	2		Integer*2
121	Position	A	397	1		E (east) or W (west)
122	Longitude	A	398	6		DDD-HH
123	Tick mark 2 data					
124	Line number	B	404	2		Integer*2
125	Pixel number	B	406	2		Integer*2
126	Position	A	408	1		E (east) or W (west)
127	Longitude	A	409	6		DDD-HH
128	Tick mark 3 data					
129	Line number	B	415	2		Integer*2
130	Pixel number	B	417	2		Integer*2
131	Position	A	419	1		E (east) or W (west)
132	Longitude	A	420	6		DDD-HH
133	Tick mark 4 data					
134	Line number	B	426	2		Integer*2
135	Pixel number	B	428	2		Integer*2
136	Position	A	430	1		E (east) or W (west)
137	Longitude	A	431	6		DDD-HH
138	Right border tick marks					
139	Tick mark 1 data					
140	Line number	B	437	2		Integer*2
141	Pixel number	B	439	2		Integer*2

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ANNOTATION DATA RECORD

Seq	Field description	Type	Pos	Size	Unit	Format or value
132	Position	A	441	1		N (north) or S (south)
133	Latitude	A	442	6		DDU-MM
134	Tick mark 2 data					
135	Line number	B	448	2		Integer#2
136	Pixel number	B	450	2		Integer#2
137	Position	A	452	1		N (north) or S (south)
138	Latitude	A	453	6		DDU-MM
139	Tick mark 3 data					
140	Line number	B	459	2		Integer#2
141	Pixel number	B	461	2		Integer#2
142	Position	A	463	1		N (north) or S (south)
143	Latitude	A	464	6		DDU-MM
144	Tick mark 4 data					
145	Line number	B	470	2		Integer#2
146	Pixel number	B	472	2		Integer#2
147	Position	A	474	1		N (north) or S (south)
148	Latitude	A	475	6		DDU-MM
149	Left border tick marks					
150	Tick mark 1 data					
151	Line number	B	491	2		Integer#2
152	Pixel number	B	483	2		Integer#2
153	Position	A	485	1		N (north) or S (south)
154	Latitude	A	486	6		DDU-MM
155	Tick mark 2 data					
156	Line number	B	492	2		Integer#2
157	Pixel number	B	494	2		Integer#2
158	Position	A	496	1		N (north) or S (south)
159	Latitude	A	497	6		DDU-MM
160	Tick mark 3 data					
161	Line number	B	503	2		Integer#2
162	Pixel number	B	505	2		Integer#2
163	Position	A	507	1		N (north) or S (south)
164	Latitude	A	508	6		DDU-MM
165	Tick mark 4 data					
166	Line number	B	514	2		Integer#2
167	Pixel number	B	516	2		Integer#2
168	Position	A	518	1		N (north) or S (south)
169	Latitude	A	519	6		DDU-MM
170	BLANKS	A	525	16		

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IMAGERY FILE
IMAGERY FILE

A.3 IMAGERY FILE

A.3.1 IMAGERY FILE DESCRIPTOR RECORD

Seq	Field description	Type	Pos	Size	Unit	Format or value
1	FILE DESCRIPTOR FIXED SEGMENT					
2	Record Sequence Number	R	1	4		077(8)
3	Sub Type Code #1	R	5	1		300(8)
4	Type Code	R	6	1		022(8)
5	Sub Type Code #2	R	7	1		022(8)
6	Sub Type Code #3	R	8	1		540
7	Length of this Record	R	9	4		A\$
8	ASCII/EBCHIC Flag	A	13	2		T80
9	2 Flank	A	15	2		1A
10	Software Release Number	A	17	12		1A
11	Revision Number	A	29	2		T80
12	Revision Letter Number	A	31	2		1A
13	Software Release Number	A	33	12		T80
14	Data file Number within Logical Volume	N	45	4		FORTRAN 14 format
15	File name	A	49	16		LS4\$TH\$RINGYR\$on
16	Record sequence and location type flag	A	65	1		LSS\$TH\$BINGYBil\$
17	Sequence Number Location	A	69	4		F\$EO
18	Sequence Number Field Len	A	77	2		\$\$\$\$s\$1
19	Record code and location type flag	A	81	4		\$\$\$\$
20	Record code location	A	85	4		FTYP
21	Record code field length	A	89	4		\$\$\$\$
22	Record length and location type flag	A	93	4		\$\$\$\$
23	Record length location	A	97	8		FLGT
24	Record length field length	A	105	8		\$\$\$\$s\$9
25	Flag indicating whether data interpretation information is included in the file descriptor record	A	113	1		\$\$\$\$s\$4
26	Flag indicating whether data interpretation information is included in records other than file descriptor	A	114	1		Y
27	Flag indicating whether data display information is included in the file descriptor record	A	115	1		N
28	Flag indicating whether data display information is included in records other than file descriptor	A	116	1		Y
29	Reserved Segment	A	117	64		N
30	FILE DESCRIPTOR VARIABLE SEGMENT					
31	Number of image records	N	181	6		FORTRAN 16 format
32	Image record length	N	187	6		FORTRAN 16 format
33	Reserved	A	193	24		BLANKS
34	Pixel Group Data					

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IMAGERY FILE
IMAGERY FILE DESCRIPTION RECORD

Scan	Field description	Type	Pos	Size	Unit	Format or value
32	Number of bits per pixel	A	217	4		\$\$\$
33	Number of pixels per group	A	221	4		\$\$\$
34	Number of bytes per group	A	225	4		\$\$\$
35	Justification and order of pixels within data group	A	229	4		\$\$\$
	Image Data					
36	Number of spectral bands imagery in this file	N	233	4		FORTRAN 14 format
37	Number of lines per band excluding top and bottom lines	N	237	8		FORTRAN 18 format
38	Number of left border pixels	A	245	4		\$\$\$
39	Number of image pixels per line	N	249	8		FORTRAN 18 format
40	Number of right border pixels	A	257	4		\$\$\$
41	Number of top border lines	A	261	4		\$\$\$
42	Number of bottom border lines	A	265	4		\$\$\$
43	Interleaving indicator	A	269	4		ESQ\$ or BIL\$
	Record Data					
44	Number of physical records per line	A	273	2		\$1
45	Number of physical records per multispectral line	A	275	2		\$1
46	Number of prefix bytes per record	A	277	4		20
47	Number of image bytes/record	A	281	4		3500 for quadrant
48	Number of suffix bytes/record	A	285	4		6200 for full frame
49	Prefix/Suffix repeat flag	A	289	4		68
	Prefix/Suffix Data Locators					\$\$\$
	Locator format:					
	where:					
	bbbb - field first byte,					
	within prefix or suffix:					
	ll - field length in bytes					
	s - field is in (P) prefix					
	or (S) suffix:					
	t - type of data: A - alphanumeric					
	B - binary					
	N - numeric					
50	Scan Line Number Locator	A	293	8		00010+PB
51	Band Number Locator	A	301	8		000702PB
52	Time of Scan Line Locator	A	309	8		000904PB

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IMAGERY FILE
IMAGERY FILE DESCRIPTOR RECORD

Seq	Field description	Type	Pos	Size	Unit	Format or value
53	Left-Fill Count Locator	A	317	8		001304PB
54	Right-Fill Count Locator	A	325	8		001704PB
55	Blanks	A	333	8		
56	Scan Line Quality Locator	A	341	8		000108SB
57	Calibration Info Locator	A	349	8		000902SB
58	Gain Values Field Locator	A	357	8		00000000
59	Bias Values Field Locator	A	365	8		00000000
60	Blanks	A	373	64		
61	Number of Left Fill Bits within Pixel	A	437	4		\$\$\$0
62	Number of Right Fill Bits within Pixel	A	441	4		\$\$\$0
63	Maximum Pixel Data Range	A	445	4		\$\$\$5
64	Blanks	A	449	3152		

IMAGERY FILE
QUADRANT IMAGE DATA RECORD

A.3.2 QUADRANT IMAGE DATA RECORD

Seq	Field description	Type	Pos	Size	Unit	Format or value
1	Record sequence number	B	1	4		
2	Sub type code #1	B	5	1		355(8)
3	Type code	B	6	1		355(8)
4	Sub type code #2	B	7	1		333(8)
5	Sub type code #3	B	8	1		22(8)
6	Length of this record	B	9	4		3600
	Prefix data					
7	Scan Line Number	B	13	4		Integer*4
8	Scan Line Direction (0-forward 1-reverse)	B	17	1		Byte
9	Quadrant	B	18	1		Byte
10	Image Band Number	B	19	2		Integer*2
11	GMT satellite time code at SLS	B	21	4	milliseconds	Integer*4
12	Count of Left Fill Pixels	B	25	4		Integer*4
13	Count of Right Fill Pixels	B	29	4		Integer*4
	Image Data					
14	Image Pixels	B	33	3500		Byte
	Suffix data					
15	Seen Line Quality					
16	Sync Loss indicator (1-sync loss 0-no)	B	3533	1		Byte
17	Detector substitution indicator (1=yes 0=no)	B	3534	1		Byte
	Calibration data					
18	Detector identification	A	3535	6		Integer*2
19	Current line length of recorded image	B	3541	2		Integer*2
20	Counted full-scan line length	B	3543	4		Integer*4
21	Embedded line length	B	3547	4		Integer*4
22	Time Error from line start to mid scan	B	3551	4		Integer*4
23	Time Error from mid scan to line end	B	3555	2	clock count	Integer*2
24	Seare	B	3557	2	clock count	Integer*2
	Satellite time code at SLS	A	3559	35		
	Each element of this time code occursies					
	is in the MSB of the byte					
	four bits and the first one of the list					
25	Units of days, Tens of days	B	3594	1		Byte
26	Units of hours, Tens of hours	B	3595	1		Byte
27	Units of minutes, Tens of minutes	B	3596	1		Byte
28	Units of seconds, Tens of seconds	B	3597	1		Byte

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IMAGERY FILE
QUADRANT IMAGE DATA RECORD

Seq	Field description	Type	Pos	Size	Unit	Format or value
29	Units of seconds, Hundreds of milliseconds	B	3598	1		Byte
30	Tens of milliseconds, Units of milliseconds	B	3599	1		Byte
31	1/16 of milliseconds	B	3600	1		Byte

IMAGERY FILE
FULL FRAME IMAGE DATA RECORD

A.3.3 FULL FRAME IMAGE DATA RECORD

Seq	Field description	Type	Pos	Size	Units	Format or value
1	Record sequence number	B	1	4		
2	Sub type code #1	B	5	1		355(8)
3	Type code	B	6	1		355(8)
4	Sub type code #2	B	7	1		33(8)
5	Sub type code #3	B	8	1		22(8)
6	Length of this record	B	9	4		6300
	Prefix Data					
7	Scan Line Number	B	13	4		Integer*4
8	Scan Line Direction (0-forward 1-reverse)	B	17	1		Byte
9	Quadrant	B	18	1		Byte
10	Image End Number	B	19	2		Integer*2
11	GMT satellite time code at SLS	B	21	4	milliseconds	Integer*4
12	Count of Left Fill Pixels	B	25	4		Integer*4
13	Count of Right Fill Pixels	B	29	4		Integer*4
	Image Data					
14	Image Pixels	P	33	6200		Byte
	Suffix Data					
	Scan Line Quality					
15	Sync Loss indicator (1-sync loss 0-no)	B	6233	1		Byte
16	Detector substitution indicator (1=yes 0=no)	B	6234	1		Byte
17	T & B	A	6235	6		
	Calibration data					
18	Detector identification	B	6241	2		Integer*2
	Current line length of recorded image					
19	Counted full-scan line length	B	6243	4		Integer*4
20	Embedded line length	R	6247	4		Integer*4
21	Time Error from line start to mid scan	B	6251	4		Integer*4
22	Time Error from mid scan to line end	R	6255	2	clock count	Integer*2
23	Time Error from mid scan to line end	B	6257	2	clock count	Integer*2
24	Spare	A	6259	35		
	Satellite time code at SLS					
	Each element of this time code occupies four bits and the first one of the list is in the MSB of the byte					
25	Hundreds of days, tens of days	B	6294	1		Byte
26	Units of days, tens of hours	R	6295	1		Byte
27	Units of hours, tens of minutes	B	6296	1		Byte
28	Units of minutes, tens of seconds	B	6297	1		Byte

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IMAGERY FILE
FULL FRAME IMAGE DATA RECORD

Seq	Field description	Type	Pos	Size	Unit	Format or value
29	Units of seconds, Hundreds of milliseconds	B	6298	1		Byte
30	Tens of milliseconds, Units of milliseconds	B	6299	1		Byte
31	1/16 of milliseconds	B	6300	1		Byte

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NULL VOLUME DIRECTORY FILE
VOLUME DESCRIPTOR RECORD

A.4 NULL VOLUME DIRECTORY FILE

A.4.1 VOLUME DESCRIPTOR RECORD

Seq	Field description	Type	Pos	Size	Unit	Format or value
1	Record sequence number	B	1	4		
2	Sub type code #1	B	5	1		300(8)
3	Type code	B	6	1		300(3)
4	Sub type code #2	B	7	1		77(8)
5	Sub type code #3	B	8	1		22(8)
6	Length of this record	B	9	4		360
7	ASCII/EBCDIC flag	A	13	2		ns
8	2 Blanks	A	15	2		ss
9	Superstructure control document ID	A	17	12		CCR-CCT-0002
10	Superstructure control document revision number	A	29	2		sc
11	Superstructure record format revision letter number	A	31	2		sa
12	Software Release Number	A	33	12		TED
13	Tape ID of current physical volume	A	45	16		YYDDHH-RRRR/NI
14	Logical volume ID	A	61	16		Blanks
15	Volume Set ID	A	77	16		Blanks
16	Number of tapes on logical volume	N	93	2		FORTRAN 12 format
17	First physical volume of logical volume	N	95	2		11
18	Last physical volume of logical volume	N	97	2		FORTRAN 12 format
19	Current Physical Volume number	N	99	2		FORTRAN 12 format
20	First file number in this physical volume	N	101	4		FORTRAN 14 format
21	Logical volume number within volume set	N	105	4		FORTRAN 14 format
22	Logical volume number within physical volume	N	109	4		111
23	Logical volume creation date	A	113	3		Blanks
24	Logical volume creation time	A	121	8		Blanks
25	Logical volume generation country	A	129	12		Blanks
26	Logical volume generation agency	A	141	8		Blanks
27	Logical volume generation facility	A	149	12		Blanks
28	Number of file pointers in volume directory	A	161	4		Blanks
29	Number of records in volume directory	A	165	4		Blanks
30	Volume spare segment	A	169	92		Blanks
	Local Use Segment					
	Scene identification					
31	Instrument	A	261	2		TH
32	Satellite	A	263	1		4 or 5
33	Separator	A	264	1		-
34	Revolution	N	265	5		FORTRAN 15.5 format
35	Separator	A	270	1		-
36	Row	N	271	3		FORTRAN 13.3 format
37	Separator	A	274	1		-
38	Type of run	A	275	1		C
39	Number of the run	N	276	3		FORTRAN 13 format

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NULL VOLUME DIRECTORY FILE
VOLUME DESCRIPTOR RECORD

Seq	Field description	Type	Pos	Size	Unit	Format or value
40	Separator	A	279	1		
41	Quadrant number	N	280	1		FORTRAN I1 format
42	Separator	A	281	1		
43	Interleaving indicator	A	282	3		BIL or BSO
44	Separator	A	285	1		
45	Processed bands	A	286	7		one character per band
46	Blank	A	293	1		
47	Instrument	A	294	2		IM
48	Satellite	A	296	1		4 or 5
49	Scene center time	A	297	16		YYDDHHMMSSHHMMFF
50	WRS designator	N	313	3		FORTRAN I3 format
51	Path number	A	316	1		A or D
52	Orbital direction	N	317	3		FORTRAN I3 format
53	Row number	A	320	1		+ if out of grid, blank oth
54	Out of WRS grid indicator	A	321	8		YYYYMMDD
55	Acquisition date	A	329	8		HHMMSSXX
56	GMT acquisition time	A	337	1		
57	Blank	A	338	1		HDC: CDC ...
58	IMFL processing type	A	341	10		NNNN:MM:SS or SDDD:MM:SS
59	Scene center latitude	A	351	10		LLLL:MM:SS or WDDD:MM:SS
59	Scene center longitude	A	351	10		